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COLLECTION OF CASTOR (*Ricinus communis* L.) AND SAFFLOWER (*Carthamus* spp.) GERMPLASM IN NORTH-WESTERN HIMALAYAS AND TRANS-GANGETIC PLAINS OF INDIA

S. S. DUHOON[1], National Bureau of Plant Genetic Resources, Pusa Campus, New Delhi 110 012
([1]Present address : Project Coordinator (Sesame & Niger), JNKV Campus, Jabalpur (Madhya Pradesh)

In a crop specific exploration to collect diversity in castor (*Ricinus communis* L.) and safflower (*Carthamus tictorious* L.) and its wild relatives from north-western Himalayan region and trans-gangetic plains of India (in collaboration with Directorate of Oilseeds Research, Hyderabad, Andhra Pradesh and Project Coordinating Unit-Safflower, Solapur, Maharashtra), a total of 226 accessions representing diversity mainly in wild forms of castor (134), safflower (7) and wild safflower (56) were collected. The important variability in castor included instant shattering and forceful seed ejecting types exhibiting primitiveness, small shining heavy seeds indicating high oil contents and resistance to biotic stresses, non-spiny and non-shattering types and red rose foliage types. The variability in safflower included cold tolerant types exhibiting more similarity to *C. lanatus* L. from Hamirpur and Kangra district (Himachal Pradesh), extreme heat and drought resistant types in *Carthamus oxycantha* Bieb., cold and drought resistant types in *Carthamus lanatus* L from Phulwama and Baramulla district in Jammu & Kashmir The lower hills and submontane areas in Himalayan region were observed to be the storehouse for highly variable primitive forms of castor, distributed in truly wild state. The drier areas in Gurgaon, Mahendragarh and Bhiwani district of Haryana; Bhathinda, Barnala and Firozpur district of Punjab and adjoining pockets in Kathua district of Jammu & Kashmir were found to be the hot spots of variability in *Carthamus oxycantha* Bieb. and the nitches around Chandhara village in Phulwama District and Singhpura village in Baramulla District of Jammu and Kashmir State for *Carthamus lanatus* L. The ethno-botanical studies on the targeted species revealed that the local people, particularly the ethnic groups in the remote areas of northwestern Himalayan region, are heavily dependent on these plants to meet their medical requirements effectively.

Key words : Exploration, collection, castor, safflower, north-western Himalayas, trans-gangetic plains

Castor and safflower are very important oilseed crops of India having a lot of diversity particularly in wild and cultivated forms. The diversity in castor and safflower from north western Himalayan region and trans-gangetic plains is represented neither in the base collection at National Gene Bank at National Bureau of Plant Genetic Resources, New Delhi nor in active collections at the Directorate of Oilseeds Research (DOR), Hyderabad and Project Coordinating Unit, Solapur, Maharashtra State. Considering this gap and also the recommendations of Germplasm Advisory Committee on Oilseeds, four north Indian States i.e. Jammu & Kashmir, Himachal Pradesh representing north-western Himalayan region, Haryana and Punjab representing trans-gangetic plains were surveyed. The surveyed areas lie between 73°8′ to 78°8′ East longitude and 27°7′ to 34°5′ North latitude with an

altitudinal range of 170 to 3000 m above mean sea level. The soils in this regions are mostly sandy, sandy loam, loam, clay, silt loam and silt, stony, gravely and rocky with black, yellow, red and brown colour exhibiting wide variations in fertility levels from very poor to highly fertile.

METHODOLOGY

A circular route with coarse grid method of sampling at 10-15 km intervals was followed and occasionally super-imposed by fine grids so as to capture maximum variability (Jain, 1975 and Hawkes, 1976), particularly in the areas of the high concentration of diversity. A few to 400 mature capsules/heads/seeds, as per availability, were collected following random as well as biased sampling to collect specific genotypes (Sinha, 1981), using hand gloves and secateurs. The distinct morpho-types occurring simultaneously in the same population were sampled separately wherever possible. The passport data were recorded for each accession. The enroute diversity in other crops and wild relatives was also collected. The observations on 100 seed weight, length, breath of seed and other post harvest characters were recorded in the laboratory. Ten old traditional farmers/donors were interviewed for ethno-botanical information.

DIVERSITY COLLECTED

A total of 226 collections representing diversity in castor (134) and safflower (7), wild safflower (56) in the targeted species and others (27) was collected (Table-1) from 124 sites in extremely diverse habitats ranging from the parched sand dunes in the Thar desert to hilly dissect in high Himalayas. The diversity in other crops was represented by four samples of local landraces of maize, two samples of paddy, four samples of wild *Solanums, Saccharum*, pumpkin, and medicinal plants like ashwagandha etc. The important variability in the targeted species is discussed.

Safflower (*Carthamus tinctorius* L.)

Safflower is an erect annual herb with spinosely serrate leaves and globular flower heads. The plant is found only under cultivation and is supposed to have originated either from *C. lanatus* Linn. or C. *oxycantha* Bieb in two primary centres of origin, viz. the mountainous region of Abyssinia and Afghanistan (Kupzow, 1932). Being highly resistant to drought; it is mostly cultivated as an oilseed crop in sandy soils with poor fertility in rainfed areas, generally mixed with wheat, barley, chickpea, mustard etc. Occasionally safflower is also grown for dye purpose. It is vernacularly known as 'kusum' in Haryana and 'kusumbha' in Himachal Pradesh and Kashmir. It is used as a leafy vegetable at tender stage. The survey of literature indicated the distribution of three species of *Carthamus* i.e. *Carthamus tinctorius* Linn., the cultivated safflower and two wild species i.e. *C. oxycantha* Bieb. and *C. lanatus* L. in the targeted region. The information gathered from the folk revealed that some time 20-40 years ago, in some pockets of Hamirpur, Kangra, Una, Solan and Sirmour districts of Himachal Pradesh and Kathua district in Jammu & Kashmir State, the traditional farmers used to grow safflower landraces for personal/domestic/religious/medicinal purposes on small scale in small plots, in home steads, temple compounds and kitchen gardens. The inter culture of safflower with wheat, chickpea and other *rabi* crops was also quite common at that time. But the practice of growing safflower diminished continuously with the passage of time and the old people who used to prefer it. The diminishing of diversity was so severe that in the current exploration, out of the four states surveyed, only seven samples of *C. tinctorius* could be collected from five villages in Hamirpur and Kangra districts of Himachal Pradesh. These populations of *C. tinctorius* L. exhibited more similarity to C. *lanatus* than C. *oxycantha* in morphological characters and general appearance. A narrow range of variability

was recorded for observable traits in the sampled

Table 1. State/District wise collections of castor and safflower from Northwest Himalayas and trans-gangetic plains of India

Diversity Collected/Number of collections			
State/District	Castor (*Ricinus communis*)	Wild Safflower (*Carthamus oxycantha*)	Safflower (*Carthamus tinctorius*)
Haryana	26	31	-
Faridabad	-	7	-
Gurgaon	-	1	-
Mahendragarh	4	4	-
Bhiwani	2	3	-
Hisar	2	4	-
Sirsa	5	7	-
Ambala	3	-	-
Kurukshetra	2	-	-
Kaithal	3	3	-
Karnal	5	-	-
Sonipat	-	2	-
Punjab	34	20	-
Bathinda	1	3	-
Ludhiana	3	1	-
Gurdaspur	4	1	-
Amritsar	4	2	-
Pathankot	2	-	-
Hoshiarpur	10	-	-
Sangrur	4	2	-
Barnala	1	3	-
Firozpur	4	8	-
Patiala	1	-	-
Himachal Pradesh	55	-	7
Una	2	-	-
Solan	7	-	-
Shimla	5	-	-
Bilaspur	9	-	-
Hamirpur	3	-	4
Kangra	9	-	3
Mandi	8	-	-
Chamba	2	-	-
Kullu	3	-	-
Kinnaur	2	-	-
Sirmour	5	-	-
Jammu & Kashmir	19	5	-
Jammu	9	5	-
Doda	4	-	-
Rajauri	5	-	-
Kathua	1	-	-
Total	134	56	7
Opportunistic collections			29
Total Diversity			226

populations. The samples represented variability in sparsely spiny types, orange flower colour, medium sized capitulum/seeds with white colour, plant height (25 to 78 cm), primary branches (2 to 8) mostly on 2/3 upper portion of the plant.

Wild safflower (*Carthamus oxycantha* Bieb.)

Fifty six natural populations of *C. oxycantha* were sampled. It is vernacularly known as 'kantiali' in Haryana and 'poli' in Punjab and adjoining parts in Jammu and Himachal Pradesh. It is a medium sized (20 to 85 cm), bushy and thorny herb, growing wild in the arid tract of the surveyed areas. It is a trouble some weed found abundantly in the harvested fields of wheat, gram, lentil, mustard and other *rabi* crops. *C. oxycanth* exhibited high concentration of diversity in drier parts in Gurgaon, Mahendragarh, Bhiwani, Hisar and Sirsa districts of Haryana; Bathinda, Patiala, Sangrur, Barnala and Firozpur districts of Punjab; Kathua district of Jammu & Kashmir and Una district of Himachal Pradesh. In the areas of abundance, poor people use its oil for illumination and edible purpose. The seeds are collected and parched and eaten as such or mixed with wheat or gram. The plant is said to be good fodder at tender stage but the mature plant is hardly touched, unless the spines are broken by beating with sticks. The samples exhibited variability in plant height (20-85 cm), branching habit (basal/top branching and intermediate types), capitulum size, (small to medium), seed colour (white, gray, mottled gray, black and brown with and without blotches), seed size, spininess (sparse to dense).

Carthamus lanatus L.

It is found in Kashmir and Himachal Pradesh from 1500 to 1800 m. above mean sea level and locally known 'kant' or 'kand'. A thorough search was made during the exploration. A few colonies

of *C. lanatus* could be identified as weed in saffron (*Crocus sativus* L.) fields in Chandhara village in Phulwama district, located 20 km away from Srinagar on Jammu- Srinagar high way. Some colonies also existed in apple orchards around Singhpura village, 5 km from Sopore town in Baramulla district. The plants in all the colonies were at flowering stage and hence collections of seed could not be possible. However the sites where these colonies existed, were shown to the Scientists of Sher-e-Kashmir University of Agril. Sci. & Tech. Srinagar, for the purpose of their collection at the time of seed maturity, probably in the middle of August.

Castor (*Ricinus communis* L.)

Castor is an important oilseed crop of India, cultivated for seeds which yield a fast drying, non-yellowing oil used mainly in industry and medicines. The castor is believed to be a native of tropical Africa. India is considered as a secondary centre of diversity/origin of castor and Indo-gangetic plains are the centre of Botanical variability (Stuhlmann, 1909; Kulkarni and Ramamurthy, 1977; Moskin, 1986; Anjani et. al, 1993 and Duhoon et al, 1996). Through its occurrence in scrubby jungles of the outer Himalayas in a truly wild state, together with the antiquity of its use as drug in Sanskrit literature are held to a point to its being the native of India as well of Africa. Castor oil has great industrial and medicinal value. The species is common throughout the country in all climates ranging from tropical, subtropical to temperate, with high concentration of diversity in the direr parts with tropical climate. 'Errand' and 'arandi' are the local/vernacular names of castor in this region.

The castor, in the surveyed region, grows as natural wild or as escape near road/river-sides, back/court yards, temple compounds, wastelands and most preferably on garbages around the village. The organized cultivation of castor as a main crop is not seen in the targeted areas. Occasionally the castor is grown as guard/fence rows to protect the main crop from men/animals. The early types mature in May/June, whereas the late types mature in June/July. The plants, if not uprooted or cut, become perennial and gradually grow into trees up to 7-8 m height. Nevertheless, good extent of variability occurred in the targeted areas. One hundred thirty four populations or individual plant samples representing local diversity in castor were collected from 125 sites in diverse habitats ranging from road/river sides, courtyards/backyards and waste lands/garbage's around villages, farmers fields. The collected samples represented diversity from an altitudinal range of 170 to 1600m above mean sea level. Out of 134, 54 samples represented diversity from Himachal Pradesh and 19 from Jammu & Kashmir and thus collectively these 73 samples represented diversity from northwestern Himalayan region. Whereas 34 samples collected from Punjab and 22 samples from Haryana summing up to 56 combinedly represented diversity from trans- gangetic plains. At the district level, the maximum number of 9 samples each collected from Kangra and Bilaspur in H.P.; Jammu in J & K and Hoshiarpur district in Punjab. Besides, a good extent of diversity was recorded in Solan, Mandi, Rajauri and Sangrur district. The spiny and shattering types were more frequent than non-spiny and non-shattering types throughout the regions surveyed. However the non-spiny and non-shattering types were endemic in their distribution with high frequency from Ramdas village to Attari border Check Post in Amritsar district near Indo-Pakistan border. The primitive types showing instant shattering with forceful cracking of capsules and ejecting the seeds, were concentrated in submontane areas and lower hills around Pathankot and Jammu. The castor collections exhibited variation in seed colour (gray, brownish white, brown, red and black with and without mottling), seed size (small, medium to bold), seed shape (elongated, square, oblong

and triangular), appearance (shining and dull), plant/spike colour (green, sun-red and golden), spike (short/long and compact/loose), spike length (10 to 75 cm), leaf size (small/large), leaf lobing (deep/shallow), growth habit (fast growing, tall types and slow growing), shattering and non shattering types and early and late maturing types. The extent of variability in 100 seed weight was very high varying from as low as 6.3 g. (Accession SKY-11) to as high as 19.0 g (Accs. SKY-59). Seed length varied from 0.62 cm (SKY-15 and SKY-94) to 12.5 cm (SKY-102), Seed breadth exhibited variation from 0.47 cm (SKY-1) to 1.07 cm (SKY-48).

ETHNOBOTANICAL USES

The information on indigenous knowledge and the various ethnobotanical uses of *Carthamus* species and castor were collected from the local farmers through personal interviews. It was observed that all the arial parts of the plant are used for various purposes as listed below.

(a) Safflower (*Carthamus tinctorius* L.)

- The petals are used as a substitute of saffron and also as edible due to colour rice and other foods. The dried petals are also used to adulterate saffron.

- Dried petals are soaked in water and this water is used as a substitute of holy Ganga water in all the rituals from birth, marriage to death by the Hindus in Hamirpur, Kangra, and Unna district of Himachal Pradesh.

- Tender shoots of safflower are used as leafy vegetable and are very rich in proteins and vitamins.

- The flowers are used as stimulant, sedative and emmenagogue.

- The charred oil is used for healing sores and the massage effectively controls rheumatism.

- Safflower is grown continuously for 12 years by a family to worship God for blessings and to come out of the evil star effects.

- Equal amount of dried petals of safflower, tea and zinger are boiled in water or milk and sugar is added to the taste. This preparation is taken regularly to effectively control the rheumatism and spondulitis. Alternatively the decoction of dried petals is also used by the locals to treat rheumatism and the joints pain.

- The mature seeds are soaked in water and grinned to form a paste. The paste is cooked in milk and sugar is added to taste. This preparation, locally called as 'kheer', is aphrodişiac in nature and given to improve the vigour and sexual potential of males.

(b) Wild safflower (*Carthamus oxycantha* Biet.)

- The powder of the dried petals mixed with honey s given to cure cough and cold by the locals in the drier parts of Haryana.

- The plant at the flowering stage is chopped in to pieces and the equal amount of chopped Dhuwansa plant are boiled in water. The boiling is done till 1/3 of water remains and crystal sugar (*Mishry*) is added to it. This decoction is given for the treatment of sunstroke or related headache or migraine.

- The paste of the crushed seed is applied for ripening of tumor particularly developed due to hair uprooting.

- Decoction of the petals is given to control joint pain or arthritis in the Kathua district by Kashmiries.

- The castor seed and castor oil are very common ingredients of Indian folk medicines, particularly for the treatment of arthritis, asthma, boils, burns, cold, colic, constipation, dermatitis, fever, flu, headache, rhemuatism and skin scores.

- The green leaves of castor, coated with mustard oil, are mildly heated and bandaged to cure muscular/joint pains.

- The paste of crushed castor seed is applied externally for the treatment of ulcers.

- Castor oil is used in massage by the local women to make their skin smooth, tight and more beautiful.

- Castor oil is used with sweet and hot milk as a purgative to cure intestinal disorders.

- The massage of castor oil and garlic is used by the locals for the treatment of rheumatism and arthritis.

- The external application of the paste of crushed castor seed or castor oil mixed with sulphur powder acts as counter irritant in scorpion sting and skin scores.

OPPORTUNISTIC COLLECTIONS

The enroute interesting diversity in non-targeted species was also collected. Twenty nine samples included the land races of maize (sweet and tasty type with bold yellow grains and cobs); 'kashiatu' a land race of rice with high nutritional value, especially eaten by the ladies at the time of delivery; awnless wheat, wild species of *Solanum, Hordium, Avena, Nicotiana, Mlilotus, Saccharum* and medicinal plants like *Citrulus, Abrus,* Aswagandha (*Withania somanifera*), Chakshu, Khoob kalla, Haloshena, Bahng jira etc. used by the local people inhabiting the explored areas.

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